FIRST PART: DEMENSIONAL ANALYSIS

EXERCISE 01:

Study the homogeneity of the following equations:

- ✓ $C = P + \rho . g . z$ *In which P represents pressure, p stands for density, z denotes height, and C remains a constant.*
- ✓ $2(x_0 - vt) = gt^2 \sin(\theta)$
- ✓ $v = -\frac{f}{R} gt + \sqrt{2Lg \sin(\theta)}$

Where x_0 *is the initial position, v is velocity, L is distance, f and Rn are reaction forces,* θ *is an angle, and t and T are times.*

EXERCISE 02:

Consider the physical quantities s, v, a and t with dimensions [s]= L , [v]= LT^{-1}*, [a]=* $L\,T^{-2}$ *, and [t]= T. Check whether each of the following equations is dimensionally consistent:*

s= vt +0.5 a t^2 *s = v*t^2*+0.5 a.tv = sin (a*t^2*/s)*

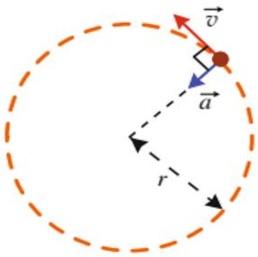
EXERCISE 03:

Determine the dimension of the variable 'X' that achieve dimensional consistency for the equation, given that 'h' represents height, "v" is the velocity and 'm' represents mass.

$$\frac{1}{2} m\, v^2 = m\, X\, h$$

EXERCISE 04:

A particle moves with a constant velocity v *in a circular orbit of a radius* r *as shown in the facing figure. The magnitude of its acceleration is proportional to some power of* $r (r^n)$*and some power of* v (v^m)*. Determine both powers* n *and* m *of* r *and* v *respectively.*



SECOND PART: VECTORS

EXERCISE 01:

Consider the following points: A (1, 1, 1), B (2, -1, 0), and C (0, 2, 2).

1- *Represent these points in a Cartesian coordinates system (O, xyz)*

2- *Determine the components of the vectors* $\overrightarrow{AB}$ *and* $\overrightarrow{BC}$

3- *Calculate the angle M between the two vectors* $\overrightarrow{AB}$ *and* $\overrightarrow{BC}$*.*

EXERCISE 02:

Using the graphical and analytical methods, find the sum and subtraction of the following vectors

$$\vec{V_1} = 3\vec{\iota} + 3\vec{\jmath}\vec{V_2} = 2\vec{\iota} + 2\vec{\jmath}$$

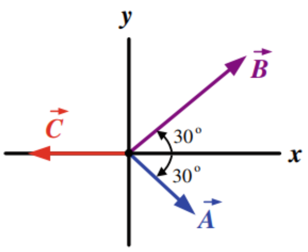
Find the angle formed by $\vec{V_1}$ and $\vec{V_2}$

Calculate the dot (scalar) product and the cross (vector) product of $\vec{V_1}$ and $\vec{V_2}$

EXERCISE 03:

Vector $\vec{A}$ has x and y components of 4 cm and -5 cm, respectively. Vector $\vec{B}$ has x and y components of -2 cm and 1 cm, respectively. If $\vec{A} - \vec{B} + 3\,\vec{C} = \vec{0}$, then what are the components of the vector $\vec{C}$.

Three vectors are oriented as shown in Figure below, where A = 10, B = 20, and C = 15 units. Find: (a) the x and y components of the resultant vector $\vec{D} = \vec{A} + \vec{B} + \vec{C}$, (b) the magnitude and direction of the resultant vector $\vec{D}$.



EXERCISE 04:

In a direct orthonormal coordinate system $\Re(\vec{\iota}, \vec{\jmath}, \vec{k})$ we consider the following vectors:

$$\vec{V_1} = 3\vec{\iota} + 3\vec{\jmath}\vec{V_2} = \vec{\iota} + 3\vec{\jmath} + \vec{k}\vec{V_3} = \vec{\iota} - \vec{\jmath} + 2\vec{k}\vec{V_4} = 2\vec{\iota} - \vec{k}$$

- ✓ *Represent the vectors $\vec{V_1}$and $\vec{V_2}$.*
- ✓ *Calculate the magnitude of $\vec{V_1}$and $\vec{V_2}$, the dot product $\vec{V_1}.\vec{V_2}$and the cross product $\vec{V_1}\Lambda\vec{V_2}$.*
- ✓ *Calculate the angle θ formed by the vectors $\vec{V_1}$and $\vec{V_2}$.*
- ✓ *Prove that the vector $\vec{V_3}$ is perpendicular to the plane (P) formed by vectors $\vec{V_1}$and $\vec{V_2}$.*
- ✓ *Provethat the vector $\vec{V_4}$ belongs to the plane (P).*
- ✓ *Determine the unit vector $\vec{U}$ carried by the vector $\vec{V_1}$and $\vec{V_2}$.*